

Serial No. 10/715,376  
Docket No. YOR920030332US1

REMARKS

Claims 1-27 and 30-36 are all the claims presently pending in the application. Claims 2-7, 9-11, 13-27 and 30-34 have been withdrawn from prosecution as allegedly directed to a non-elected species. Claims 28-29 have been canceled. Claim 34 has been amended. Claims 35-36 have been added.

It is noted that the claim amendments are made only for more particularly pointing out the invention, and not for distinguishing the invention over the prior art, narrowing the claims or for any statutory requirements of patentability. Further, Applicant specifically states that no amendment to any claim herein should be construed as a disclaimer of any interest in or right to an equivalent of any element or feature of the amended claim.

Claim 1 stands rejected under 35 U.S.C. §102(b) as allegedly being anticipated by Chen et al. (U.S. Patent No. 5,917,749). Claims 1 and 8 stand rejected under 35 U.S.C. §102(e) as being allegedly being anticipated by Ikeda et al. (U.S. Patent No. 6,721,201). Claim 12 stands rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Ikeda in view of Nakada et al. (U.S. Patent No. 6,341,053).

These rejections are respectfully traversed in view of the following discussion.

I. THE CLAIMED INVENTION

Applicant notes that the features of the exemplary aspects of the claimed invention which are described in this Amendment may pertain only to those particular aspects of the claimed invention. These features are not necessarily included in other aspects of the invention and, therefore, the description of such features in this Amendment should in no way be considered as limiting other aspects of the invention which may be disclosed in the present Application or which may be the subject of other patents or patent applications.

The claimed invention, as exemplarily described by independent claim 1, is directed to a spin-current switched magnetic memory element, including a plurality of magnetic layers, at least one of said plurality of magnetic layers having a perpendicular magnetic anisotropy component and having a current-switchable magnetic moment, and at least one barrier layer formed adjacent to said plurality of magnetic layers.

In conventional magnetic memory elements, the threshold current is too high (e.g., by at least an order of magnitude) for successful insertion into current generation complementary metal oxide semiconductor (CMOS) circuits (Application at page 2, lines 5-8).

Serial No. 10/715,376  
Docket No. YOR920030332US1

The claimed invention, on the other hand, includes a plurality of magnetic layers, at least one of said plurality of magnetic layers having a perpendicular magnetic anisotropy component and having a **current-switchable** magnetic moment. That is, unlike conventional magnetic memory elements, the claimed invention may utilize the perpendicular magnetic anisotropy component observed in some magnetic thin films to at least substantially offset (e.g., counter-balance) the strong demagnetization effect  $4\pi M_s$ , thus removing the main barrier for current induced magnetic reversal, and reduce the switching current threshold (Application at page 9, line 22-page 10, line 4).

## II. THE ELECTION OF SPECIES REQUIREMENT

The Examiner alleges that 2-7, 9-11, 13-27 and 30-34 are directed to a non-elected species. Applicant respectfully submits however, that this is completely unreasonable.

With respect to the election of species requirement, Applicant again submits that even assuming (arguendo) that the alleged "species" are distinct, the Examiner has not made a reasonable allegation that there would be some undue burden if the Examiner examined claims 1-17 and 30-33 together. Applicant respectfully submits that the Examiner MUST MAKE A PRIMA FACIE CASE OF SERIOUS BURDEN to support the election of species requirement. Applicant would again point out that MPEP §802.01 states that "a serious burden on the examiner may be prima facie shown if the examiner shows by appropriate explanation of separate classification, or separate status in the art, or a different field of search". However, nowhere has the Examiner made a reasonable allegation of undue burden.

Therefore, the Examiner is again respectfully requested to withdraw the election of species requirement.

## III. THE ALLEGED PRIOR ART REFERENCES

### A. Chen

The Examiner alleges that Chen teaches the invention of claim 1. Applicant submits, however, that there are features of the claimed invention that are not taught or suggested by Chen.

Specifically, Applicant respectfully submits that Chen does not teach or suggest "*a plurality of magnetic layers, at least one of said plurality of magnetic layers having a perpendicular magnetic anisotropy component and comprising a current-switchable magnetic*

Serial No. 10/715,376  
Docket No. YOR920030332US1

*moment*", as recited, for example, in claim 1.

Clearly, this feature is not taught or suggested in Chen.

Indeed, Applicant respectfully submits that the Examiner is missing a very important point of the claimed invention. Namely, a magnetic memory element (e.g., nanomagnet) that is switchable by a spin-polarized current (or spin-current as recited in claim 1) is a fundamentally different device than those switchable by a magnetic field induced by passing a current in close proximity, or in some instances, directly through, the switching nanomagnet.

Such differences, and the technical merit of a spin-current switchable nanomagnet device were detailed in numerous publications (e.g., J. Z. Sun, "Current-driven magnetic switching in manganite trilayer junctions", *Journal of Magnetism and Magnetic Materials* 202 (1999), pp. 157-162, and J. A. Katine, et al. "Current-Driven Magnetization Reversal and Spin-Wave Excitations in Co/Cu/Co Pillars", *Physical Review Letters*, Vol. 84, No. 14 (April 3, 2000) (which are submitted in an Information Disclosure Statement concurrently herewith); M. Hosomi et al., "A Novel Nonvolatile Memory with Spin Torque Transfer Magnetization Switching: Spin-RAM", IEEE (2005), and J. Z. Sun et al. "Spin angular momentum transfer in a current-perpendicular spin-valve nanomagnet" (which are attached hereto as Exhibits 1 and 2, respectively); and Yiming Huai et al. "Observation of spin-transfer switching in deep submicron-sized and low-resistance magnetic tunnel junctions", *Applied Physics Letters*, Vol. 84, No. 16 (19 April 2004) (which was submitted in an IDS herein on November 19, 2003)), as well as in several important land-mark patents (e.g., U. S. Patent No. 5,695,864 which was submitted herein in the November 19, 2003 IDS, and U. S. Patent No. 6,130,814 which was cited by the Examiner in the May 11, 2006 Office Action).

Applicant respectfully submits that the Examiner's misunderstanding of this fundamental difference is at the root of the prior art rejections.

For example: on page 5 of the Office Action, starting with the first line, the Examiner cites Chen et al. as disclosing "a 'current-switchable' magnetic moment; and at least one barrier layer (fig3 layer 12)...." However, it is clear from the context as well as the drawings in Chen that Chen's "current" is to induce a magnetic field which acts on the magnetic layer so as to induce the switching. This is conceptually different from claim 1 which recites a "spin-current switched (e.g., switchable) magnetic memory element", and a "current-switchable magnetic moment".

Serial No. 10/715,376  
Docket No. YOR920030332US1

Chen's device is also structurally different from the claimed invention (e.g., claim 1), in that Chen's current does not need to be "spin-polarized". Indeed, Chen never teaches or suggests the nature of his current in terms of its spin-polarization. Chen teaches that the current flows near or passes by one of the magnetic layers only to generate a magnetic field. **Chen's current for switching operation does not pass through the "stack" containing the magnetic tunnel junction.**

In the claimed invention, however, a spin-current, or spin-polarization may be induced by passing the current through the magnetic layers (e.g., the stack containing a magnetic tunnel junction). The claimed invention may use a spin-current to switch a nanomagnet, which could in fact be generalized to device geometries where the spin-current is generated elsewhere. Fundamentally, the current in the claimed invention may use spin to induce a magnetic switch.

Chen's current, on the other hand, generates a magnetic field which then induces magnetic switch. These are two fundamentally different physical processes, and two classes of fundamentally different device structures, to which numerous publications and patents can attest (e.g., including those cited above).

Further, Applicant submits that without the teachings of the present Application (e.g., and related disclosures) teaching the merits of a spin-current in inducing magnetic reversal, persons skilled in art would not be able to extrapolate from Chen to the claimed invention (e.g., the inventors' proposed device structure), because the structure is physically different, and involves a fundamentally different principle of operation.

Therefore, Applicant submits that there are features of the claimed invention that are not taught or suggested by Chen. Therefore, the Examiner is respectfully requested to withdraw this rejection.

#### B. Ikeda

The Examiner alleges that Ikeda teaches the invention of claims 1 and 8. Applicant submits, however, that there are elements of the claimed invention that are not taught or suggested by Ikeda.

Specifically, like Chen, Ikeda does not teach or suggest "*a plurality of magnetic layers, at least one of said plurality of magnetic layers having a perpendicular magnetic anisotropy component and comprising a current-switchable magnetic moment*", as recited, for example, in

Serial No. 10/715,376  
Docket No. YOR920030332US1

claim 1.

Clearly, this feature is not taught or suggested in Ikeda.

Indeed, Applicant submits that the exact same misunderstanding that caused the Examiner to rely on Chen, causes the Examiner to also rely on Ikeda.

In Ikeda, as in Chen, the current used to induce magnetic switch is one that is used to first generate a magnetic field. Ikeda never teaches or suggests the use of a spin-current in his patent. Similar to the case of Chen's patent, Ikeda's current, while may be passing through the magnetic layer that it intend to switch, does not pass through the magnetic tunnel junction for inducing a spin-current to cause a switching of the nanomagnet.

This in combination of the lack of any knowledge and description of the nature of spin-polarization lead to the conclusion that Ikeda's device is fundamentally different from the claimed invention, both in concept and operation, and in physical rendition of the device layout.

Thus, like Chen, nowhere does Ikeda teach or suggest at least one magnetic layer having a current-switchable magnetic moment. Thus, Ikeda clearly does not teach or suggest the claimed invention.

Further, Applicant respectfully submits that without the teachings of the present Application (e.g., and related disclosures) teaching the merits of a spin-current in inducing magnetic reversal, persons skilled in art would not be able to extrapolate from Ikeda to the claimed invention (e.g., the inventors' proposed device structure), because the structure is physically different, and it involves a fundamentally different principle of operation.

Therefore, Applicant submits that there are features of the claimed invention that are not taught or suggested by Ikeda. Therefore, the Examiner is respectfully requested to withdraw this rejection.

### C. Nakada

The Examiner alleges that Ikeda would have been combined with Nakada to form the invention of claim 12. Applicant submits, however, that these references would not have been combined and even if combined, the combination would not teach or suggest each and every element of the claimed invention.

Applicant respectfully submits that these references are unrelated and would not have

Serial No. 10/715,376  
Docket No. YOR920030332US1

been combined as alleged by the Examiner. Thus, no person of ordinary skill in the art would have considered combining these disparate references, absent impermissible hindsight.

Further, Applicant submits that there is no motivation or suggestion in the references to urge the combination as alleged by the Examiner. Indeed, these references clearly do not teach or suggest their combination. Therefore, Applicant respectfully submits that one of ordinary skill in the art would not have been so motivated to combine the references as alleged by the Examiner. Therefore, the Examiner has failed to make a prima facie case of obviousness.

Moreover, neither Ikeda, nor Nakada, nor any combination thereof teaches or suggests "*a plurality of magnetic layers, at least one of said plurality of magnetic layers having a perpendicular magnetic anisotropy component and comprising a current-switchable magnetic moment*", as recited, for example, in claim 1.

Clearly, this feature is not taught or suggested in Nakada. In fact, nowhere does Nakada teach or suggest at least one magnetic layer having a **current-switchable** magnetic moment. Thus, Nakada clearly does not teach or suggest the claimed invention.

In fact, Nakada simply discloses a magnetic tunnel junction process for read-out operation. The Nakada process, like the Ikeda magnetic-field switched device, could not be used, either separately or in combination, to allow a spin-current based "write" operation, which is what the claimed invention may involve.

It is therefore impossible for a person skilled in the art to arrive at the claimed invention based on the teachings of Ikeda and Nakada. Thus, Nakada clearly does not make up for the deficiencies in Ikeda.

Therefore, Applicant submits that these references would not have been combined and even if combined, the combination would not teach or suggest each and every feature of the claimed invention. Therefore, the Examiner is respectfully requested to withdraw this rejection.

#### IV. FORMAL MATTERS AND CONCLUSION

In view of the foregoing, Applicant submits that claims 1-27 and 30-36, all the claims presently pending in the application, are patentably distinct over the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue at the earliest possible time.

Should the Examiner find the application to be other than in condition for allowance, the

Serial No. 10/715,376  
Docket No. YOR920030332US1

Examiner is requested to contact the undersigned at the local telephone number listed below to discuss any other changes deemed necessary in a telephonic or personal interview.

The Commissioner is hereby authorized to charge any deficiency in fees or to credit any overpayment in fees to Assignee's Deposit Account No. 50-0510.

Respectfully Submitted,

Date: 9/11/06

  
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**CERTIFICATE OF FACSIMILE TRANSMISSION**

I hereby certify that the foregoing was filed by facsimile with the United States Patent and Trademark Office, Examiner Thinh Nguyen, Group Art Unit # 2818 at fax number (571) 273-8300 this 11th day of September 2006.

  
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